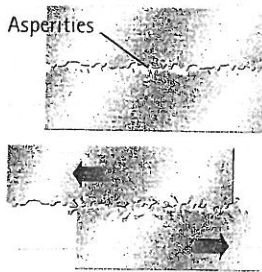


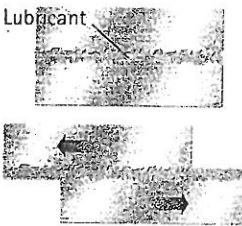
supplementary
reading - Sci (7) B

FRICTION

Friction is a force that acts against the movement of surfaces that are in contact. Friction changes kinetic energy into heat energy as it resists motion.



Even a polished metal surface is covered with microscopic rough points called asperities. These points lock into one another and cause friction when the surfaces move.



A film of lubricating oil holds the two metal surfaces apart. They slide past each other without making contact. Friction is reduced and movement creates far less heat.

When NASA's space shuttle enters the Earth's atmosphere at over 15,500 mph (25,000kph), friction with air molecules brakes the craft and raises its skin temperature to around 1,500°C. Friction is at work everywhere. Some of its effects are unwanted; others are useful.

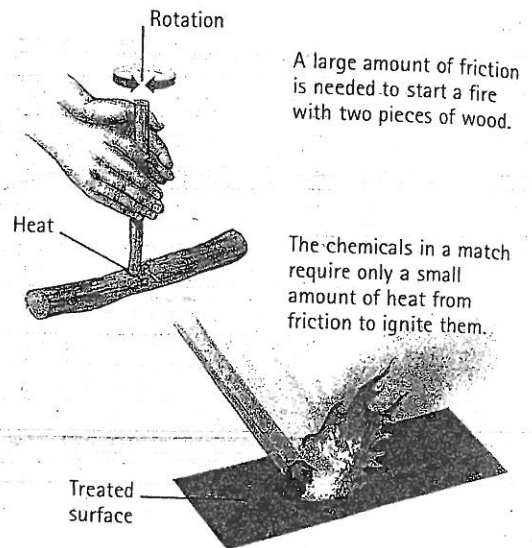
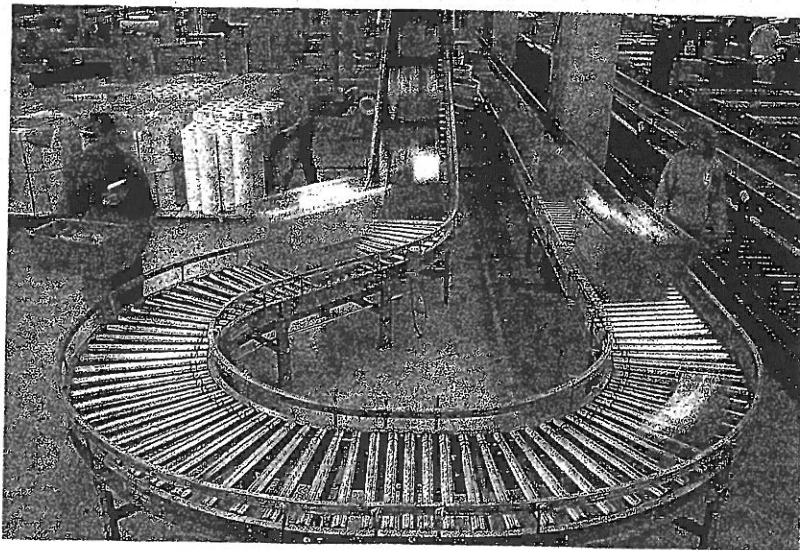
USEFUL EFFECTS OF FRICTION

Humans walk forward by pushing backward with feet. Without friction, floors, roads, and sidewalks would be more slippery than an ice rink. People would fall as they tried to walk or run. It would also be impossible to pick up objects with completely slippery surfaces.

STATIC FRICTION

If a person tries to push a loaded crate along the floor, the force that resists the motion of the crate is friction. As the strength of the push increases, there comes a point when the crate starts to move. The force just before the crate moves is the limit of static friction. It depends on the combined weight of the crate and its contents. If the weight doubles, the limit of static friction also doubles.

The limit of static friction also depends on the materials of the surfaces in contact, in this case the crate and the floor.



MAKING FIRE

The simplest equipment for making fire depends on friction and consists of two dry wooden sticks. One stick is rapidly rotated against another until friction raises the temperature to around 570°F (300°C), and the wood starts to smolder.

Matches also use friction. When the head of a match is rubbed against the rough strip on the matchbox, friction makes the temperature rise. The heat causes chemicals in the match head and the strip to react together. As the temperature increases further, the head of the match burns in air and finally ignites the wood.

SLIDING AND ROLLING

Friction is a problem when moving loads. Early humans dragged loads on heavy sleds, or wooden sledges. The sled runners helped to support the loads, but there was still a great deal of friction between the moving runners and the ground.

Humans later discovered that rollers made it much easier to move heavy objects such as blocks of stone. Rollers rotate and reduce friction because the load does not slide in contact with the ground as it travels. The drawback of rollers is that the load leaves them behind as it travels along. Around 5,500 years ago, this problem was overcome by the invention of the wheel-and-axle combination.

Heavy parcels move easily down a gentle slope on this roller conveyor. Each roller is fixed in position and rotates with little friction as a load travels over it.

BEARINGS

Bearings are devices that support moving parts and allow them to move with less friction. Bearings are used in most types of machines, including cars, bicycles, electric motors, and roller skates. One type of bearing connects a moving shaft to a static support. Other bearings connect rotating objects to static shafts. Without bearings, friction between the two parts would slow the machine, waste energy as lost heat, and rapidly wear the surfaces in contact.

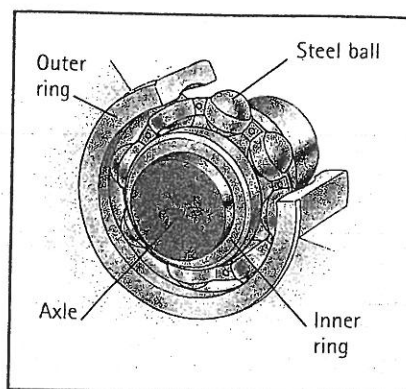
A typical bearing consists of an inner and an outer metal ring. In ball bearings, steel balls run in grooves between the two rings. In roller bearings, steel cylinders roll between the inner and outer rings. High-quality bearings can run so smoothly that friction wastes less than one percent of the energy consumption of a machine.

LUBRICANTS

Lubricants are fluids that hold sliding surfaces slightly apart to reduce friction. Mineral oils are the most common machine lubricants. Internal-combustion engines contain pumps that supply oil to lubricate the pistons as they slide inside cylinders. Oil is also continuously supplied to the bearings inside these engines.

Some machines use high-pressure air to lubricate air bearings that support shafts that rotate at extremely high speeds; others use graphite as a solid lubricant.

▼ Friction between the bobsled's metal runners and the ice is low because the downward pressure melts the ice to form a thin lubricating layer of water.



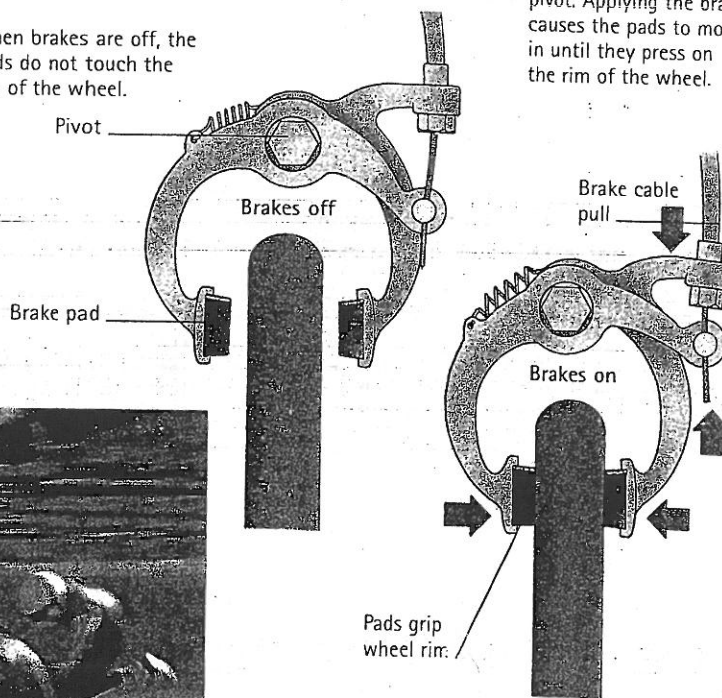
Each wheel of a roller skate is supported by a bearing. Steel balls roll inside grooves cut into the inner and outer rings.



SLOWING DOWN

Vehicles use bearings to reduce friction and help them move with the minimum amount of effort. Brakes cause deceleration by increasing the force of friction on wheels. Applying the brakes presses a hard pad of heat-resistant material against a steel drum or disk attached to each wheel. Friction between the material and the revolving part changes kinetic energy into heat and reduces the vehicle's speed. Heat is quickly lost to the surrounding air.

When brakes are off, the pads do not touch the rim of the wheel.



▼ Bicycle brakes usually consist of a pair of hard rubber pads mounted at the ends of curved levers. These levers are attached to the bicycle frame by a pivot. Applying the brakes causes the pads to move in until they press on the rim of the wheel.

When brakes are on, the pads grip the wheel rim from either side. Friction between the pads and the rim converts the cycle's kinetic energy into heat as they reduce its speed.

SEE ALSO PAGES:

106-7 Muscles and movement, 292-3
Potential and kinetic energy, 296-7
Momentum, 302-3
Wheels and axles

Name: _____

Friction Article

Directions: Read the article entitled "Friction" and answer the following questions.

1. What is the definition of friction?

2. List all the types of friction.

3. How does friction create a fire?

4. What are two ways to reduce friction?

5. How does friction work in cars?

6. Friction converts kinetic energy into what other type of energy?

7. What are microscopic rough points called?

8. What types of equipment use bearings?

9. How does a match light?

10. What is static friction?